Dream ESP Experiments and Geomagnetic Activity

MICHAEL A. PERSINGER AND STANLEY KRIPPNER

ABSTRACT: The 24-hour periods in which the most accurate telepathic dreams occurred during the Maimonides studies displayed significantly quieter geomagnetic activity than the days before or after. This statistically significant V-shaped temporal sequence in geomagnetic activity was not evident for those periods when less accurate dreams occurred. When geomagnetic activity around the time of the strongest experimental telepathic dreams was compared to the geomagnetic activity around the time of spontaneous telepathic dreams from the Gurney, Myers, and Podmore (1886) collection, very similar (statistically indistinguishable) temporal patterns were observed. Analyses of both experimental and spontaneous telepathic experiences indicated that they were more accurate (or more likely to have occurred) during 24-hour intervals when the daily average antipodal (aa) index was approximately 10 ± 3 gammas. When the daily aa index exceeded amplitudes of approximately 20–25 gammas, telepathic experiences became less probable.

Determination of the mechanism by which telepathy occurs would facilitate its understanding and control. The first step to the isolation of mechanism requires the identification of some measurable variable that is systematically associated with the occurrence of telepathy. Spontaneous telepathic experiences concerning death or crises occur more frequently during days in which the global geomagnetic activity is significantly less than the days before or after the experiences. A very similar pattern has been shown for the Gurney, Myers, and Podmore (1886) collection from the last century (Persinger, 1987), the Sidgwick (1922) collection from early in this century (Arango, 1988), and for the unverified reports published in *Fate* magazine (Persinger & Schaut, 1988; Schaut & Persinger, 1985).

The systematic association between specific temporal patterns in daily average geomagnetic activity and the likelihood of a telepathic occurrence does not by itself reveal mechanism. There are at least three classes of explanations. Periods of sudden, relatively quieter geomagnetic activity facilitate telepathy by: (a) producing environmental conditions that promote exchange of information between the agent and percipient, (b) allowing normal "telepathic factors" already in the environment to be amplified between the agent and the percipient, and (c) evoking transient alterations in brain function such that normal telepathic factors (that do not change with geomagnetic activity) can affect the percipient's sensitized temporal lobes.

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At present, the association between geomagnetic activity and spontaneous telepathic experiences suggests the existence of a persistent factor that may serve as an empirical handle by which to study the phenomena. If this utilitarian objective is to be achieved, however, the geomagnetic activity pattern should also be observable in *experimental* cases of telepathy. This association would also support the presumption that spontaneous and experimental telepathy are indeed similar phenomena. Several studies have shown statistically significant relationships between changes in daily geomagnetic activity and accuracy during remote viewing (Adams, 1986), the Circular Matching Abacus Test (Tart, 1988), and more recently, both Ganzfeld sessions and restricted-choice computer games (Haraldsson & Gissurarson, 1987).

One of the best known examples of experimental telepathy involves the dream telepathy research that was inaugurated by Montague Ullman, Stanley Krippner, and Charles Honorton during the 1960s (see Ullman, 1969; Ullman & Krippner, 1970, 1978). These studies were conducted at the Dream Laboratory of the Maimonides Medical Center in Brooklyn. To determine if the geomagnetic effect was evident in these data, the present study was designed to examine three hypotheses:

1. Nights on which the strongest experimental telepathy occurred would also be nights that displayed the quietest geomagnetic activity compared to the days before and after (i.e., is the V-shape effect apparent?).
2. Cases that demonstrated weak or questionable telepathy should not demonstrate the V-shape effect.
3. Both the strongest cases of telepathy from the Maimonides studies and the most accurate cases from the spontaneous telepathic experiences from Gurney, Myers, and Podmore (1886) should demonstrate the same temporal pattern of daily geomagnetic activity (the V-shape).

PROCEDURE

Dream Telepathy Protocol

The typical procedure followed at Maimonides was for the percipient (or subject) to arrive at the laboratory in time to meet the agent—a person who would spend much of the night focusing upon the contents of an art print. The percipient's task was to dream about this art print even though it would not be selected until the percipient was isolated from the agent. The percipient would also meet the two experimenters who would explain the procedures. (On a few occasions in which possible clairvoyance was studied, the art print was selected randomly, was not removed from the sealed envelope, and no agent was used. The percipient was simply instructed to attempt to dream about the art print.)

After electrodes were attached to the percipient's head for the monitoring of brain waves and eye movements, the percipient would have no

further contact with the agent until the following morning. An experimenter threw dice that in combination with a random number table provided a number that corresponded to a number on a sealed envelope containing an art print. The envelope was opened once the agent reached his or her private room in a distant part of the building. This art print became the target on which the agent focused during the course of the night (Ullman & Krippner, 1970, 1978).

The experimenters took turns monitoring the percipient's sleep. Toward the end of each period of rapid eye movement (REM), the percipient was awakened by an experimenter via intercom and described any dream content that could be recalled. These comments were tape recorded, as was a morning interview in which the percipient associated to his or her dream recall. The interview was conducted double blind; neither the percipient nor the experimenters knew the identity of the target or the pool of art prints from which the target had been randomly selected.

The target for a given night and the dreams for the night often contained a number of striking similarities, suggesting that an anomaly (so-called "telepathy") had occurred. For example, on May 23, 1966 the target was a print of a zebra painted by an unknown Indian artist. The percipient dreamed about a "horse show," a "horse race," and a "striped tie." But it could have been the case that simply by chance any transcript of a night's dreams might have contained passages of striking similarity to any picture to which they might have been compared (Child, 1985).

To evaluate the chance hypothesis, the Maimonides team obtained judgments of similarity between the dream content and each of the other potential targets in the pool from which the actual target had been randomly selected. Typically, three judges were used who worked blind and independently from each other with materials that had been mailed to them. They had no information about which picture had been randomly selected as the target. Any extrachance difference between targets and nontargets in their similarity to dream content was considered an apparent anomaly. Typically, the target pools used by the judges were duplicates that had never been handled by the agents.

Although percipients sometimes evaluated their own dreams against the target pool (before they discovered the identity of the actual target), and although some experiments required the judges to rate target/dream similarities on a 100-point scale, the only form in which data were available for all sessions was a count of judges' hits and misses. If the actual target had been ranked in the upper half of the target pool (e.g., #1, #2, #3 in a pool of six) for similarity to the dreams and postsleep interview, the outcome was considered a hit. If the actual target had been ranked in the lower half of the pool (e.g., #4, #5, #6 in a pool of six), the outcome was considered a miss. The median score of the three judges was selected to determine hits and misses.

For the purposes of this study, the ranks were divided into four categories. A "high hit" would be a rank in the top quartile (e.g., #1 or #2 in a

pool of eight; #1 in a pool of six); a "low hit" would be a rank in the second quartile (e.g., #3 or #4 in a pool of eight; #2 or #3 in a pool of six). A "high miss" would be a rank in the third quartile (e.g., #5 or #6 in a pool of eight; #4 or #5 in a pool of six); a "low miss" would be a rank in the fourth quartile (#7 or #8 in a pool of eight; #6 in a pool of six). In other words, these four groups represented judges' ranks of successive order from strongest "hits" to strongest "misses."

The data from the first night each subject spent at the Maimonides Laboratory were utilized, and the data from any other nights were discarded. The rationale was quite simple: Some subjects only spent one night at Maimonides; to use the second or third night would have resulted in a smaller pool. If the last night had been utilized, there may well have been a built-in difference between subjects unfamiliar with the procedures (those spending only one night in the laboratory) and those quite familiar with laboratory procedures (those spending several nights). On the basis of this decision, 62 experimental nights were available for analysis—18 "high hits," 29 "low hits," 7 "high misses," and 8 "low misses." The 62 cases represent the total collection of subjects seen between 1964 and 1969 at Maimonides.

Geomagnetic Data and Analyses

The daily average aa (antipodal) index (Mayaud, 1973) was selected as the measure of global or planetary geomagnetic activity. The aa index is the oldest continuous geomagnetic index (started in the year 1868) and was used as the measure of global geomagnetic activity for the Gurney, Myers, and Podmore (1886) cases that occurred between the years 1868 and 1886 (Persinger, 1987). By using this index, direct comparisons could be made between the experimental cases from the Maimonides dream telepathy studies and the spontaneous telepathic experiences from *Phantasms of the Living*.

Although the aa values are based upon data from only two stations (one in each of the hemispheres), the daily aa index is highly correlated (.95) with other more well-known daily global measures that utilize the magnetic activity from several geomagnetic observatories. The daily values correspond to the mean amplitude (in gammas or nanoTeslas, nT) of the displacement from a standardized baseline. Average daily aa values are derived from the eight 3-hour values (smallest temporal increment). The average daily value (the one used in our analyses) is considered a good indication of planetary activity, as defined by its near-continuous distribution (Bubenik & Fraser-Smith, 1977). Although local variations in the amplitude of geomagnetic activity do occur, the average daily temporal pattern of the changes in amplitude are *relatively* similar everywhere. The only exception to this statement occurs in areas that are subject to transient geomagnetic anomalies during geomagnetic storms in which the effects of stronger static components can also emerge.

Daily average aa values for the northern hemisphere were collected for each of the 7 days before, each of the 7 days after, and on the day each session began. Because most of the dreaming occurred during the early morning of the following day, it was selected as the key day. In order to be commensurate with previous studies involving spontaneous experiences (Persinger, 1987; Persinger & Schaut, 1988; Schaut & Persinger, 1985), this 24-hour period was selected as the "key" day instead of the (evening of the) day before when the session was started. Mean monthly aa values for months in which the experiences occurred were also listed.

We selected SPSSX MANOVA (multivariate analysis of variance) as the primary procedure because of the dependence (statistically significant intercorrelation) between geomagnetic activity during any 2 to 3 successive days. The basic design was daily geomagnetic activity by group, that is, the log (base of 10) of the daily aa values for 7 days (key day $\pm$ 3 days) and the two groups (strong cases of telepathy vs. the reference cases). Log values were used in order to reduce the contribution from days that contained extreme outlier values. (This procedure attenuated this problem within acceptable levels as defined by the lack of statistical significance displayed by the multivariate test for homogeneity of the dispersion matrices.) The total of 7 days (key day $\pm$ 3 days) of geomagnetic activity was selected before the study began in order to be comparable and compatible with the analyses of spontaneous telepathic experiences (Persinger, 1987; Persinger & Schaut, 1988; Schaut & Persinger, 1985).

To test the first hypothesis, MANOVA was completed for the daily geomagnetic values (that served operationally as "repeated" measures) and two independent variables: groups (high-hit vs. low-hit groups) and gender (male vs. female). The latter variable was included because the possible differential sensitivity of females has been inferred from the markedly enhanced incidence of female percipients in spontaneous cases (Persinger, 1974). The numbers of subjects for each group were high hit—male: 12, high hit—female: 6, low hit—male: 20, low hit—female: 9. Because of the small sample size for each of the other two categories (7 for high miss and 8 for low miss) and our reluctance to combine them, these cases were not included in this analysis. (Also, the issue of psi missing was considered to be an additional problem that would be best addressed elsewhere.) To test the second hypothesis, paired (correlated) t tests were completed between the geomagnetic activity for the key day and each of the other 6 days for the strongest telepathic cases (high hits) and weaker cases (low hits), *separately*.

In order to test the third hypothesis, the Gurney, Myers, and Podmore database (Persinger, 1987) was combined with the Maimonides data. To specifically check the similarity in geomagnetic activity (the V-shape) around the days on which telepathy occurred, a MANOVA was completed as a function of 7 days of geomagnetic activity (key day $\pm$ 3 days) and the two databases: the strongest Maimonides cases (n = 18) versus the primary spontaneous cases (n = 78). To minimize the possible weighting

from the larger number of cases in the latter group, we decided to compare the experimental cases with a subset of the spontaneous cases that contained a comparable number of subjects. By requesting all of the records that involved the dream modality (which was considered optimal in light of the Maimonides experiments) for one decade (1877 through 1886), a total of 22 cases was obtained. All analyses were completed using SPSSX software on a VAX computer.

Results

Verification of Hypotheses

A simple plot of the average daily aa values for the 7 days before, the days of, and the 7 days after the beginning of the sessions for the high hit (n = 18) and low hit (n = 29) groups is shown in Figure 1.. As can be seen, the only statistically significant difference between the two groups occurred on the day after the beginning of the session. This day (called the key day for all subsequent analyses) included the late evening and early morning hours during which time the dreaming and telepathic experiences occurred. The statistical significance of the quieter geomagnetic activity during the 24-hour period in which the strongest telepathy occurred was evident for the absolute aa values ($F[1,45] = 4.67$, $p = .04$) (even with the statistically significant difference in group variances [Bartlett-Box =

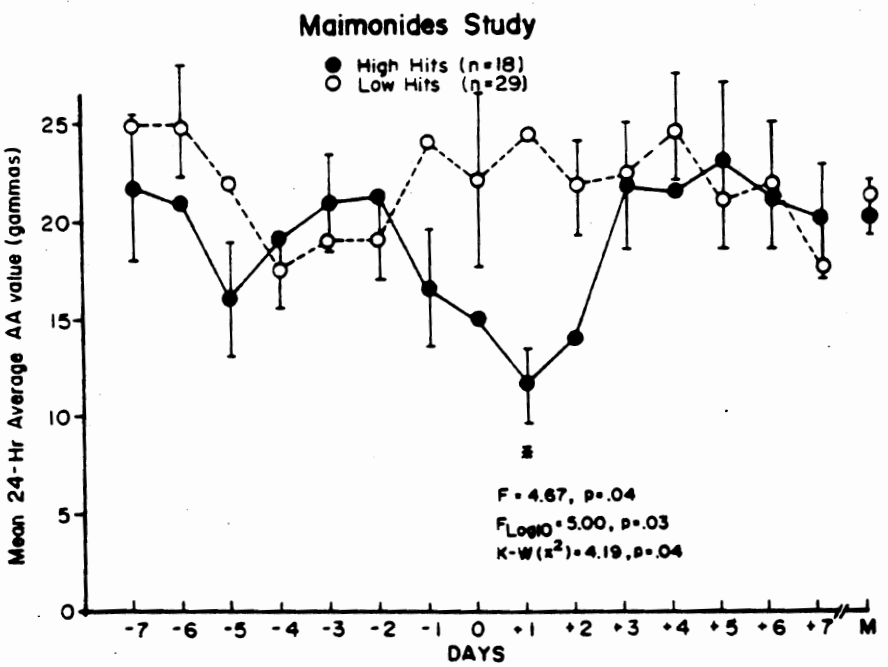

Figure 1. Mean average daily aa values (in gammas) for the days before (−), days after (+), and the days of the beginning of the sessions for the high-hit (closed circles) and low-hit (open circles) dream telepathy groups. Vertical bars indicate standard errors (±1) of the means. M refers to the mean aa values for the months in which the experiences occurred.

21.29, $p < .001$]) and the log base 10 transformations ($F[1,45] = 5.00$, $p = .03$) that eliminated the statistically significant difference in group variances; a nonparametric test (Kruskal-Wallis) also demonstrated the significant effect ($\chi^2 = 4.19$, $p = .04$).

The first MANOVA according to the two groups with different accuracy of dream telepathy (high hit vs. low hit), gender, and the seven successive days of (log base 10) geomagnetic activity (key day ± 3 days) did not reveal a statistically significant group ($F[1,43] = 1.19$, $p = .28$), gender ($F[1,43] = 0.20$, $p = .66$) or group by gender ($F[1,43] = 0.14$, $p = .71$) interaction effects. Although there were no statistically significant interactions between gender and the geomagnetic activity on the different days during, before, and after the dreams and gender ($F[6,258] = 0.15$, $p = .99$) or geomagnetic activity by gender by group ($F[6,258] = .012$, $p = .99$), there was a significant daily geomagnetic activity by group interaction ($F[6,258] = 2.97$, $p = .008$). The multivariate test for homogeneity of dispersion matrices was not significant ($p > .05$). (The geomagnetic activity by group interaction for the absolute aa values was also statistically significant [$F(6,258) = 2.21$, $p = .04$], even though the dispersion matrices were not homogeneous.)

As can be seen in Figure 2A, the source of the interaction was due primarily to the lower geomagnetic activity on the nights of the dreams that contained the greatest accuracy (high hit: strongest telepathy) compared to the nights of dreams that contained less accuracy (low hit: weaker telepathy). Whereas the geomagnetic activity on the nights of the strong telepathic cases was significantly less (paired $t[17] = 4.55$, $p \leq .001$) than the monthly average of the months in which the dreams occurred, the geomagnetic activity on the nights of the weaker telepathy dreams was not significantly different from the monthly geomagnetic activity (paired $t[28] = 1.49$, $p = .07$).

These results supported Hypothesis 1, which predicted that the geomagnetic activity should be significantly lower during 24-hour periods in which dream telepathy was strongest, as defined by the greater accuracy of target material. Paired t tests between the log base 10 of the aa values on the key day and for each of the other 6 days demonstrated statistically significant differences between the key day and 3 days before ($t[17] = 3.14$, $p = .003$), 2 days before ($t[17] = 2.60$, $p = .009$), and 3 days after ($t[17] = 3.58$, $p = .001$) for the high-hit group only. However, there were no significant differences between the geomagnetic activity on the key day and each of the other 6 days for the group of telepathic dreams that were less accurate. These results supported Hypothesis 2.

The MANOVA between the two groups of data revealed that the strongest (high hit) telepathic cases ($n = 18$) from the Maimonides study and the spontaneous cases ($n = 78$) demonstrated that the log base 10 of the average geomagnetic activity (Figure 2B) was significantly lower during the week of the spontaneous cases (that occurred between the years 1868 and 1886) relative to the experimental cases ($F[1,94] = 5.18$, $p =$

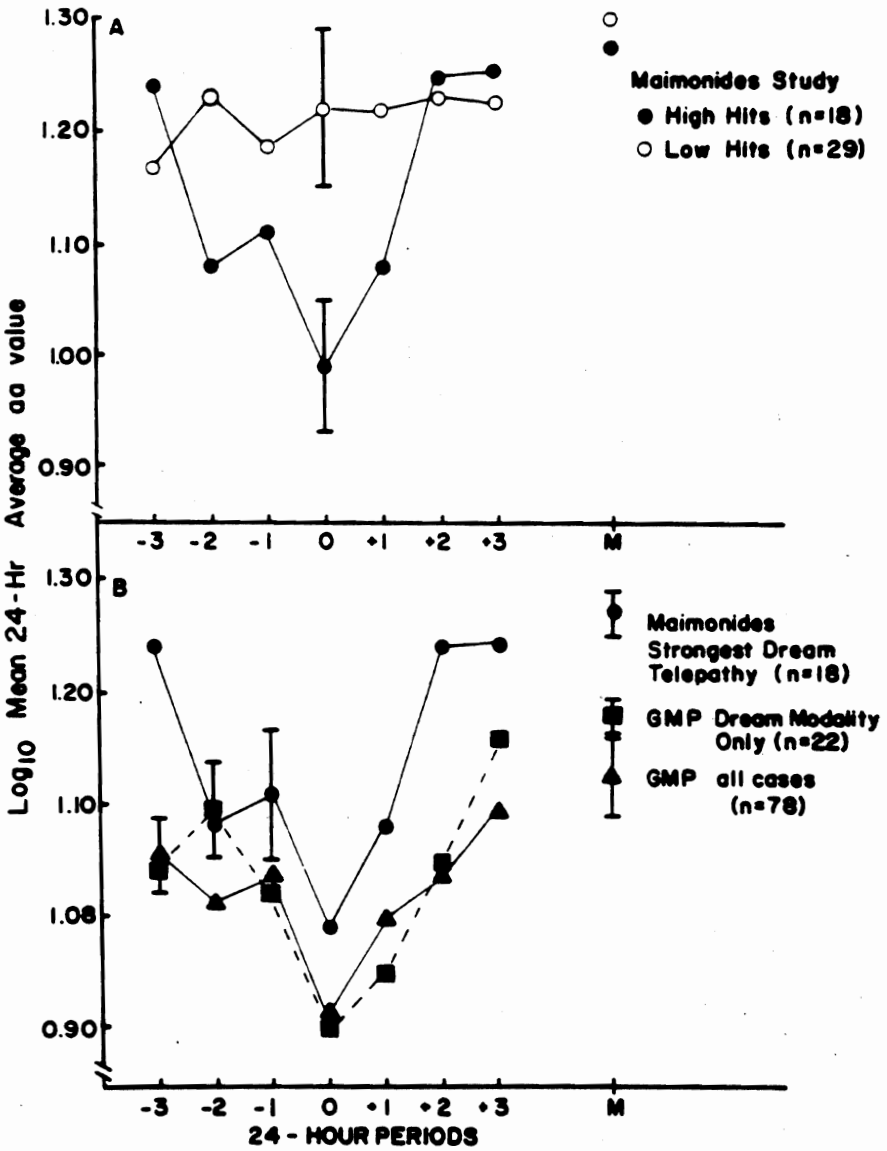

Figure 2. Log (base 10) of the mean daily aa values for the 24-hour periods during, before (−), and after (+) the key days (0) when (A) strong and weaker experimental telepathic dreams occurred during the Maimonides Series, and (B) spontaneous telepathic experiences (Gurney, Myers, & Podmore, 1886) occurred. M refers to the means of the monthly aa averages. Vertical bars indicate standard error of the mean.

.025). Although there was no statistically significant days by group interaction ($F[6,564] = 0.76$, $p = .60$), there was a highly significant difference between the geomagnetic activity across the 7 days, regardless of group factors ($F[6,564] = 4.29$, $p = .0003$). Because paired t tests between the geomagnetic activity on the key days and the 3 days before and after had been already completed for the Maimonides strongest telepathy cases, paired t tests (all 77 *df*) were completed for the Gurney, Myers, and Podmore data. The geomagnetic activity on the key days was significantly lower than all of the other days (± 3 days) before or after (t values ranged

from 2.41 to 4.29). In addition, the geomagnetic activity on the day of the spontaneous experiences was significantly lower than the average values for months in which they occurred ($t[77] = 7.18, p < .001$).

MANOVA with the Maimonides data and the 22 cases of *dream modality only* from the spontaneous cases (Figure 2B) also showed a significant difference in geomagnetic activity between the days during, before, or after the experiences ($F[6,228] = 4.00, p = .0008$). Again, there was no significant interaction between the daily geomagnetic activity and the two groups of data ($F[6,228] = 0.61, p = .72$). The average geomagnetic activity for the week of the Gurney, Myers, and Podmore cases (dream modality only) was also lower than the week in which the contemporary cases occurred ($F[1,38] = 3.80, p = .059$). The absence of significant interactions thus supported Hypothesis 3 that the two groups should show (statistically) identical temporal patterns for mean daily geomagnetic activity on the days of, before, and after the experiences.

Further Exploration and Analysis

One obvious question that emerged from this research is: What is more important: (a) the *absolute values* of the geomagnetic activity (as defined by aa values), or (b) the *relative change* in geomagnetic activity on the day of the telepathic experience? To answer this question, *T*-score values (by definition a mean of 50 and standard deviation of 10) were computed for the nontransformed (i.e., absolute) aa values for each of the 7 days for each case for both sets of data. The *T* score for the aa values for each day for each case was calculated first by subtracting the value for that day from the mean of the scores for all 7 days and then dividing this value by the standard deviation for the 7 days. After multiplying this value (effectively the scores' standard deviation) by 10 and adding it to 50, the *T* score was obtained. Although outliers could still affect the analyses, the amplitude would be minimal because they would be expressed as standard deviations with respect to the mean of the week in which the experience occurred.

The *T* score allowed analysis of the relative change in geomagnetic activity on the key day and for each of the other days with respect to the mean value for the week. If the relative decrease in geomagnetic activity on the day of the telepathic experience was more critical than the absolute value of the geomagnetic activity (in aa units), then the *interaction* (even though the "repeated" measure would be invariant, i.e., singular variance-covariance matrix for each cell) between the high-hit group (strongest telepathy) and the low-hit group (weaker telepathy) should be even more significant than determined in the previous analysis. MANOVA between the *T* scores of the aa values for the key day $\pm$ 3 days for the two Maimonides groups demonstrated no statistically significant day by group interactions ($F[6,270] = 1.51, p = .17$). These results strongly suggested that the *absolute value* of the geomagnetic activity was

more critical than the relative change of activity during the weeks of the dreams.

Comparison of the monthly aa values (log base 10) between the Gurney, Myers, and Podmore data and the 18 cases of the strongest experimental dream telepathy results indicated that the geomagnetic activity during the months of the 22 *dream modality* cases (years 1877 to 1886) was less than that during the months of the Maimonides studies ($F[1,38] = 14.19$, $p < .001$). However, there was no statistically significant difference between the geomagnetic activity during the 24-hour intervals of the experimental and spontaneous telepathic experiences ($F[1,38] = 1.03$, $p = .32$). The lack of a significant difference in geomagnetic activity on the days of the experiences for the two groups (even though monthly values differed) also supports the hypothesis that the *absolute amplitude of geomagnetic activity* rather than the relative change is the critical feature for facilitating telepathic experiences.

Discussion

The results of this study indicate that the 24-hour periods during which experimental telepathic dreams were most accurate (strongest) were associated with significantly quieter planetary geomagnetic activity compared to ± 3, 24-hour periods before and after. The V-shaped pattern of geomagnetic activity over days (with the trough occurring on the night of the telepathic dreams) was not observed in cases that were considered to be weaker indications of dream telepathy as defined by an objective ranking procedure. These results support the hypothesis that quieter periods of geomagnetic activity facilitate the occurrence of experimental telepathic experiences.

The pattern of the geomagnetic activity for the week (key day $\pm$ 3 days) of the strongest cases of dream telepathy was also identical (i.e., not statistically distinguishable) from the V-shaped pattern in geomagnetic activity that was observed in the spontaneous telepathic experiences from almost a century ago. This similarity suggests that some geomagnetic factor may influence the occurrence of both experimental and spontaneous telepathic experiences in a similar manner. Comparable V-shaped relationships have been observed with other collections of spontaneous telepathic experiences (Persinger & Schaut, 1988).

Persistence of a geomagnetic factor in telepathic experiences has at least one theoretical and one practical implication. First, the similarity of geomagnetic activity patterns around the days of both experimental and spontaneous telepathic experiences suggests that the two classes of phenomena are indeed related. Second, the occurrence of the geomagnetic V-shaped effect, assuming the sample size is appropriate, might be used as an indicator of the occurrence of telepathy within novel experimental designs. Significant differences within any experimental context, despite appropriate controls and valid statistical treatments, may not necessarily involve

traditional telepathic processes. If the geomagnetic factor continues to be evident with well-established databases of both experimental and spontaneous telepathic cases, then its *absence* may serve as an indicator of the presence of some other factor that might be generating quasi-psi. Consequently, confusion about telepathy and argumentation between experimenters who use different procedures might be attenuated.

A preliminary answer to the question of whether or not the absolute level of geomagnetic activity rather than a *relative* decrease in geomagnetic activity is the critical factor was obtained in this study. When *T*-score transformations of the geomagnetic activity for each case were computed for each day with respect to its standard deviation from the week of activity, the differences between the strongest and weaker experimental cases were not significant. In addition, there was no significant difference between the geomagnetic activity during the 24-hour periods of experiences for either the spontaneous telepathic experiences or the experimental dream reports, despite the elevated mean monthly aa values in the latter cases.

This pattern suggests that aa values of approximately 10 gammas (95% confidence interval of 8 to 13 gammas) are highly associated with the occurrence of a classic telepathic experience. If the aa values approach 25 gammas or more (95% confidence interval of 18 to 34 gammas), the mean value for the low-hit dream telepathy group, an (accurate) telepathic experience is less likely to occur. The reliability of the approximately 10 aa unit value is supported by the spontaneous cases from Gurney, Myers, and Podmore (1886). The mean of the aa values for the 24-hour periods in which all verified experiences occurred (n = 78) was 10 gammas (95% confidence interval of 9 to 12 gammas), whereas the mean aa value for dream only experiences was 12 gammas (confidence interval of 8 to 16 gammas). It is interesting that the mean aa values for the 24-hour period in which the 133 unverified telepathic experiences from *Fate* occurred (Persinger & Schaut, 1988) was 14 gammas, a value that is expected to be inflated due to poorer controls during case collection. For comparison, the means of the aa values for the days before the occurrence of these experiences ranged between 24 to 26 gammas.

The tendency for both spontaneous and experimental telepathic experiences to occur during the nights of 24-hour periods in which the mean aa amplitudes were approximately 10 gammas may facilitate the isolation of mechanism. However, it is not clear at present whether the optimal condition is the simple occurrence of geomagnetic activity within the range of 10 gammas, regardless of activity during the previous 3 days, or whether the optimal condition occurs when there is a sudden change from some previous higher activity (aa 25 or greater) to within the range of 10 gammas within a 24-hour period. Both the spontaneous cases and the experimental telepathy data indicated that the actual absolute decrease in average daily geomagnetic activity was about 10 to 15 gammas.

The specification of this range of sudden decrease (by 10 to 15 gammas)

in geomagnetic activity is important for precise isolation of mechanism. If, for example, some extremely low frequency magnetic field factor (Matsushita & Campbell, 1967) is involved with the transmission of information, then its occurrence should be maximally correlated with the 24-hour periods in which the aa values are within the 10-unit range and/or those days in which the aa values approach 10 after a sudden decrease in activity. Whereas the first option would suggest a steady-state telepathic factor that is linearly related to the presence and duration of geomagnetic activity within the optimal range, the second option argues strongly in favor of a derivative solution that requires the optimal rate of change in geomagnetic activity within a specific temporal interval.

If, on the other hand, one assumes that the geomagnetic factor is coupled exclusively with its effect on the *sensitivity of the brains* of the people involved in the experience (agent and/or percipient, depending upon the model), then the mechanism would involve some important neuroelectrical or neurohormonal alteration that is sensitive to (a) average daily geomagnetic activity in the range of 10 gammas or (b) a decrease in average daily geomagnetic activity by about 15 gammas to a value of approximately 10 gammas. That the human brain may be sensitive to subtle geomagnetic activity within this order of magnitude has been discussed previously (Becker & Selden, 1985; Persinger & Schaut, 1988).

A critique of the geomagnetic effect in traditional telepathic experiences has been developed by Hubbard and May (1986). They have attempted to indict the validity of these studies by implying that (a) there is no strong evidence of the biological effectiveness of either extremely low frequency or ultralow frequency magnetic fields and (b) the aa indices (and indeed geomagnetic indices in general) are not adequate indicators of geomagnetic activity for parapsychological studies. Although provocative and certainly worthy of consideration, their arguments are neither accurate nor relevant to this study.

First, there are both strong and consistent data that time-varying magnetic fields within the geomagnetic range affect living systems (Ahlbom, Albert, Fraser-Smith, Grodzinsky, Marron, Martin, Persinger, Shelanski, & Wolpow, 1987; Persinger, 1988). Changes in specific behaviors (e.g., associated with circadian variations) and particular chemical pathways (e.g., indolamines) have been systematically associated with near-natural low-frequency magnetic field exposures. The variability and inconsistency that exist within the scientific literature are in large part associated with the inappropriate conceptual aggregation of studies that involve different frequencies, intensities, and systems. To argue that effects of time-varying magnetic fields upon living systems are inconsistent (and hence questionable) is equivalent to dismissing pharmacological effects because different drugs produce different responses. In addition, if the "controversial nature" of an effect was considered a criterion for its rejection, the subject matter of parapsychology would be excluded totally.

Hubbard and May's second major argument involves the alleged de-

crease in coherence between mean daily geomagnetic activity in different localities. Hubbard and May fail to specify how much discoherence actually occurs and within what latitudinal boundaries. Extreme coherence in geomagnetic activity between stations is important for geophysical modeling. However, intercorrelations of even .80 between the average daily geomagnetic activity near all stations within the continental United States, for example, would be sufficient to demonstrate the geomagnetic field effect, considering the mean decrease of 10 to 15 gammas from a baseline of about 20 to 25 gammas (i.e., about 50% of the amplitude) that is associated with days of strong telepathic experiences. Indeed, even a random selection of two very distant stations, such as between Fredericksburg, Virginia and Anchorage, Alaska during the last 6 months of 1987, demonstrates a Pearson correlation coefficient of .85 and a Spearman correlation of .92 between the average daily activity (A index) for the two stations. Even weaker interspatial correlations of geomagnetic activity would not necessarily contest the validity of the phenomenon, if the shared variance of geomagnetic activity between loci was the same source with which telepathic experiences were associated.

From an operational perspective, technical discussion concerning the geomagnetic indices with respect to psi phenomena is analogous to an obsession with decimal points when the background fluctuations in the phenomenon involve a large range of integers. Compared to measures of telepathic experiences, the numerical reliability between geomagnetic indices is extremely robust. The arguments concerning precision may be discipline specific (see Mayaud, 1980, for examples) and of questionable relevance to the understanding of psi mechanisms. At most, the discrepancies noted by Bubenik and Fraser-Smith (1977) as reported by Hubbard and May (1986) would reduce the strength of the geomagnetic effect in telepathic experiences rather than artifactually evoke it.

Despite these interesting questions concerning the degree of variability in the spatial homogeneity of geomagnetic activity, Hubbard and May's (1986) argument is not relevant to this study. Because all of the Maimonides data were collected in the same place, the problem of "different geomagnetic measures at different locations" has questionable significance. Similarly, most of the cases for the Gurney, Myers, and Podmore collection occurred within 100 km (the reason that our analysis originally was performed) of the sensor that was used for the calculation of the aa values and during a period when human-caused electromagnetic noise would have been much lower than today. The fact that the geomagnetic pattern was similar in both shape and amplitude in two clusters of telepathic experiences that were separated by several thousands of kilometers and by a century challenges the validity of the "overconcern" with geomagnetic indices.

The issue of cultural electromagnetic signals within the intensity and frequency range of geomagnetic activity, an important component of Hubbard and May's (1986) approach, may be useful for the isolation of the

mechanism by which the geomagnetic effect occurs. They postulated that a geomagnetic-telepathic effect could be negated because signals generated by a direct current train system (BART) within the San Francisco Bay Area can exceed background geomagnetic activity by an order of 1 to 3 (Fraser-Smith & Coates, 1978; Ho, Fraser-Smith, & Villard, 1979), depending upon proximity to the system. What Hubbard and May did not state is that (a) the characteristics of these transient signals are markedly different in both form and temporal structure from those associated with geomagnetic storms, and (b) these humanly manufactured signals are effectively absent during the early morning hours (0100 to 0500 local time) when traditional spontaneous psi experiences tend to occur most frequently. Indeed, the presence of human-made electromagnetic signals and the determination of the degree of their similarity to natural patterns may allow innovative approaches to the study of how both classes of stimuli effect the occurrence (suppression or facilitation) of traditional telepathic experiences.

However, the importance of the absolute value of the geomagnetic activity (or its relative, sudden decrease) as a facilitator of spontaneous or experimental telepathic experiences would argue strongly in favor of on-site measurement as suggested by Hubbard and May. Careful analysis of these records might isolate optimal parameters in the temporal structure of local field variations. Although the daily average geomagnetic measures over months between stations are highly correlated, latitude-specific local hourly variations (especially during solar quiet periods), local human-caused electromagnetic noise, and natural anomalies (e.g., buried ore deposits) are sufficient to affect the local expression of global geomagnetic activity. On-site monitoring and consequent correlation with indices of planetary activity may further reveal the local signatures that modulate the hourly variations in the occurrence and accuracy of telepathic experiences.

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Behavioral Neuroscience Laboratory
Department of Psychology
Laurentian University
Sudbury, Ontario, P3E 2L6
Canada

Saybrook Institute
1550 Sutter Street
San Francisco, California 94123